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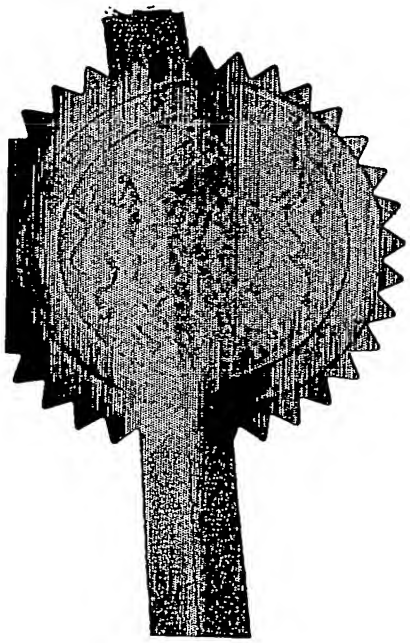

Signed P. Mahoney

Dated 18 May 2004

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04SEP03 E835051-1 D02835
P01/7700 0.00-0320721.4

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Cardiff Road
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1. Your reference — SMR/P550660R2

2. Patent application number *(The Patent Office will fill in this part)* — 04 SEP 2003 — 0320721.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

   ATL Engineering (UK) Limited
   Unit 15 Peartree Business Centre
   Peartree Road
   Stanway
   Colchester
   Essex CO3 5JN

   08000523001
   Patents ADP number *(if you know it)*

   If the applicant is a corporate body, give the country/state of its incorporation — UK

4. Title of the invention — AN INFINITELY VARIABLE CONTINUOUS RECLINER FOR VEHICLE SEATS AND SIMILAR APPLICATIONS

5. Name of your agent *(if you have one)*

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   URQUHART-DYKES & LORD
   Midsummer House
   413 Midsummer Boulevard
   CENTRAL MILTON KEYNES
   MK9 3BN

   1644008 ✓
   Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
GB	0307987.8	7.4.03

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
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   Yes

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Description	11
Claim(s)	CF
Abstract	-
Drawing(s)	13 only

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Priority documents	-
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 4.9.03

12. Name and daytime telephone number of person to contact in the United Kingdom: Mr Simon Raynor - 01908 666645

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AN INFINITELY VARIABLE CONTINUOUS RECLINER FOR VEHICLE SEATS AND SIMILAR APPLICATIONS

The present invention relates to a continuously variable recliner for vehicle seats and similar applications.

Typically in vehicle seats the two main components are the seat cushion, which is the part one sits on, and the seat squab (seat back), which is the part one leans against. It is normal that the angle between the cushion and the squab is to be adjustable so that the seated occupant can obtain maximum comfort. This is because the body shapes and size of occupants can vary greatly. It is also desirable to have a facility of recline so that the occupant can rest in a more horizontal position.

To achieve this feature it is normal to position a mechanism such that, one side is attached to the seat cushion and the other to the seat squab, see Fig 1. Sometimes a single mechanism is used on one side of the seat with a simple pivot on the other side for low load/strength applications. Conversely for high strength seats, mechanisms are fitted on both sides.

There are a number of mechanisms used throughout the world but in general terms the range of mechanisms used can be divided into two different types.

Type 1 of the mechanism range is what is called the ratchet type recliner and is operated by the raising and lowering of a lever. These work by raising the operating lever, resetting the squab angle and then lowering the lever thus relocking the mechanism. What this does is to engage a new position on a set of teeth internally within the mechanism. The two disadvantages of the Ratchet type are:-

a) The angle of recline has increments of movement normally of about 5 degrees due to the form of the teeth. This means for example the seat cannot be set 2 degrees forwards or backwards from a locked position.

b) When the lever is raised to unlock the mechanism, the internal teeth are disengaged and the recliner should not therefore be operated while the vehicle is in motion.

Type 2 of the mechanism range is the type with a continual mesh with an infinitely variable adjustment range. Normally these mechanisms are operated by manual hand wheels although on more expensive seats, electric motors are often employed. Basically by turning a hand wheel or operating an electric switch the squab is powered backwards or forwards. When the seat is moving forwards or backwards it is continuously in mesh and can be stopped in any position within an infinitely (i.e. continuously) variable range of adjustment.

It can now be readily appreciated that Type 2 overcomes the disadvantages already outlined for Type 1.

These Type 2 mechanisms also come in a range of different designs. There are designs incorporating a worm and wheel system, others incorporate a planetary gear system where the planetary gears are meshed with internally stamped gear rings. However, the simplest and most successful of all of the infinitely variable type of mechanisms is the well tried and tested 'Taumel' system as manufactured by Keiper Recaro of Germany.

The main principle of the Keiper Recaro mechanism concerns a pair of inner/outer fine blanked tooth rings, which give it its rotation using a waltzing movement. Another feature of the Keiper Recaro Taumel mechanism relates to a wedge device, which is necessary in order to reduce play (chuck) and creep (the slow lowering of the squab under its own weight).

The present invention relates to an improved recliner mechanism. The improved mechanism makes the wedge part of the Keiper Recaro redundant by means of a new design concept for the tooth form.

The basic concept of both the new recliner mechanism and the Keiper Recaro recliner is very simple, and consists of basically two plates produced by the 'Fine Blanking Technique'. One plate is attached to the seat cushion and has an external tooth form pressed in it by fine blanking. The other plate is attached to the seat squab and in this plate an internal tooth form is pressed into it by fine blanking. The plate with the internal tooth form contains one more tooth than the plate with the external tooth form. A centrally placed eccentric cam drives the mechanism in a clockwise or anti-clockwise direction.

Various embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a vehicle seat having a recliner mechanism;

Figure 2 is a side view of a first recliner mechanism;

Figure 3 is a first isometric view of the first recliner mechanism;

Figure 4 is a second isometric view of the first recliner mechanism;

Figure 5a is a front view and figure 5b is a side view of a cam;

Figures 6a and 6b are exploded and unexploded isometric views of the first recliner mechanism;

Figure 7 is a side view of the first recliner mechanism in a partially reclined position;

Figure 8 is an isometric view of the first recliner mechanism in a partially reclined position;

Figures 9a and 9b are exploded and unexploded isometric views of a second recliner mechanism;

Figure 10 is a sectional view of the second recliner mechanism, on line X-X of figure 9b;

Figure 11 is a side view of a third recliner mechanism;

Figure 12 is a front view of the third recliner mechanism;

Figure 13 is an isometric view of the third recliner mechanism, and

Figure 14 is a sectional view of the third recliner mechanism, on line A-A of figure 11.

The vehicle seat shown schematically in Figure 1 includes a seat cushion, which is the part one sits on, a seat squab (seat back), and a recliner mechanism that connects the squab to the cushion and allows the angle of the squab to be adjusted relative to the cushion.

The first recliner mechanism comprises a cushion plate (1), a squab plate (2), a cushion clamp plate (3), a squab clamp plate/pivot support (4), a special eccentric cam (5) and finally four through plate tubular rivets (6), see FIG 2.

The cushion plate (1) is a fine blanked component with an external toothed ring (7) semi-sheared out of the base material. In the centre of the toothed ring is a hole (8), see FIG 3. Two holes at the bottom of the plate (9) are for the tubular rivets (6). The toothed ring (7) as shown here has 29 teeth equally spaced and with a very special profile which gives a touch contact point with the teeth on the squab plate (2).

The squab plate (2) is a fine blanked component with an internal toothed ring (10) semi-sheared out of the base material. In the centre of the toothed ring is a hole (11) that provides one side of a trunnion bearing for the eccentric cam (5). Two holes (12) at the top of the plate (2) are for the tubular rivets (6). The toothed ring (10) as shown has 30 teeth equally spaced, also with a very special profile that gives a touch contact point with the teeth on the cushion plate (1).

As can be seen most clearly in Fig. 2, the profiles of the internal toothed ring (10) and the external toothed ring (7) are designed so that the teeth of the two rings make contact with one another around substantially the entire circumference of the rings. Owing to the fact that the external ring has one less tooth than the internal ring, the degree of engagement varies from one tooth to the next, such that the teeth are fully engaged on one side of the mechanism (at point **A**) and fully disengaged on the opposite side (at point **B**). This arrangement removes practically all free play (chuck) from the mechanism, within manufacturing tolerances.

The cushion clamp plate (3) is a simple toggled component. It has two holes (13) at the bottom through which pass the tubular rivets (6) which effectively clamp it onto the cushion plate (1). Through the tubular rivets pass the main fixing bolts (not shown) that attach the mechanism to the cushion frame. The clamp plate (3) includes an offset arcuate flange (14) that overhangs the squab plate (2) to stop the mechanism separating in use, whilst still allowing the squab plate to revolve.

The squab clamp plate/pivot support (4) is also a simple toggled component. It has two holes (15) through which pass the tubular rivets (6) that effectively clamp it onto the squab plate (2). The clamp plate (4) includes an offset arm (16) that overhangs the cushion plate (1) to stop the mechanism separating in use, whilst still allowing the cushion plate (1) to revolve.

At the lower end of the squab clamp plate (4) is a hole (17) through which passes the bearing of a cam (5). It is now apparent that the cam is supported on one side by hole (17) and on the other by hole (11) in squab plate (2).

Through the tubular rivets (6) pass the main fixing bolts (not shown) that attach the mechanism to both the cushion and squab seat frames.

The special eccentric cam (5) is unique being different from any of the cams used in other mechanisms, due to the fact that the special tooth forms developed for this mechanism automatically hold the engaged teeth (at point A) fully enmeshed because

on the opposite side (at point B) peak to peak contact is held. Even the teeth that are not peak to peak urge the engagement of the external tooth form into the internal tooth form. This is different to current mechanisms where opposite to the enmeshed teeth there is no contact between the inner ring and the outer ring and where consequently the parts must be held in mesh by pressure of the central cam. FIG 2 shows clearly the constant contact between the teeth, which is a very important feature of the present invention.

FIG 5 shows the unique cam (5), which includes a cam profile (18) with a bearing (19) on each side. One can see that the cam profile is cut away on the left side and the right side. The curved surface at the top and bottom is designed to engage the hole (8) in cushion plate (1). Through the complete cam is a square hole (20). This hole is to accept a square shaft on which is mounted either a hand wheel or electric motor with a reduction gearbox (not shown).

Looking at FIG 5 one can see a centreline of rotation and a centreline of cam. One can be forgiven for thinking that the centreline of rotation is the same as the rotation centreline of the hand wheel, it is not. The fixed stationary point on the seat is centreline of cam, and the centreline of rotation moves around the centreline of cam in a circular motion the radius of movement being the distance from centreline of cam to centreline of rotation. This distance is a very crucial dimension when defining the tooth profiles of the relative gear rings.

As the squab moves backwards or forwards the centre of the mechanism is moving round and round. This gives a 'waltzing' movement to the squab, it is however very small and would not normally be noticeable.

Operation of the recliner mechanism will be explained with reference to figures 2 and 7, where Figure 2 shows the mechanism in a fully upright position and figure 7 shows it in a partially reclined position, with the squab plate (2) rotated through an angle of about 40°. It will be appreciated that in each case the position of maximum engagement (point A) is determined by the rotational position of the cam (5) and rotates with the cam. Since the internal tooth ring (10) has one more tooth than the

external tooth ring (7), the cushion plate (1) advances by one tooth anti-clockwise for each clockwise revolution of the cam (5). In the example shown in the drawings, the internal tooth ring (10) has 30 teeth, with an angular separation between adjacent teeth of 12°. The cam (5) has therefore rotated through approximately 3.3 revolutions clockwise to produce the 40° anticlockwise rotation of the cushion plate (1).

The second recliner mechanism shown in Figures 9a, 9b and 10 is similar in many respects to the first recliner mechanism and the same reference numbers, incremented by 100, have been used for corresponding parts.

The second recliner mechanism comprises a cushion plate (101), a squab plate (102), a cushion clamp plate (103), a squab clamp plate (104), an eccentric cam (105) and four through plate tubular rivets (106).

The cushion plate (101) is a fine blanked component with an external toothed ring (107) semi-sheared out of the base material. In the centre of the toothed ring is a hole (108) that provides the first side of a trunnion bearing for the eccentric cam (105). Two holes at the bottom of the plate are for the tubular rivets (106). The toothed ring (107) has 29 teeth equally spaced and with a profile that gives a touch contact point with the teeth on the squab plate (102).

The squab plate (102) is a fine blanked component with an internal toothed ring (110) semi-sheared out of the base material. In the centre of the toothed ring is a hole (111) that provides the second side of a trunnion bearing for the eccentric cam (105). The hole (111) has a frusto-conical form with inclined walls, as shown in Fig. 10. Two holes (112) at the top of the plate (102) are for the tubular rivets (106). The toothed ring (110) as shown has 30 teeth equally spaced, also with a profile that gives a touch contact point with the teeth on the cushion plate (101).

As in the first recliner mechanism, the profiles of the internal toothed ring (110) and the external toothed ring (107) are designed so that the teeth of the two rings make contact with one another around substantially the entire circumference of the rings.

Owing to the fact that the external ring has one less tooth than the internal ring, the degree of engagement varies from one tooth to the next, such that the teeth are fully engaged on one side of the mechanism and fully disengaged on the opposite side. This arrangement removes practically all free play (chuck) from the mechanism, within manufacturing tolerances.

The cushion clamp plate (103) is a simple toggled component having two holes (113) at the bottom through which pass the tubular rivets (106) to clamp it onto the cushion plate (101). Through the tubular rivets pass the main fixing bolts (not shown) that attach the mechanism to the cushion frame. The clamp plate (103) includes an offset arcuate flange (114) that overhangs the squab plate (102) to stop the mechanism separating in use, whilst still allowing the squab plate to revolve.

The squab clamp plate (104) is also a simple toggled component having two holes (115) through which pass the tubular rivets (106) to clamp it onto the squab plate (102). The clamp plate (104) includes an arcuate flange (116) that overhangs the cushion plate (101) to stop the mechanism separating in use, whilst still allowing the cushion plate (101) to revolve.

The cam (105) includes an eccentric circular cam profile (118) that is designed to engage the hole (108) in cushion plate (101). A frusto-conical bearing (119) provided on one face of the cam is designed to engage the frusto-conical hole (111) in the squab plate (102). Extending through the cam is a square hole (120). This hole is designed to accept a square shaft on which is mounted either a hand wheel or electric motor with a reduction gearbox (not shown). A circular flange (121) that extends outwards beyond the periphery of the cam profile is provided adjacent the face with the bearing (119).

An annular friction disc (122) made for example of polyurethane is located on the circular cam profile (118) and is compressed between one face of the flange (121) and the opposed face of the cushion plate (101). The friction disc provides a controlled degree of static friction, which prevents undesired rotation of the cam and eliminates any tendency of the squab to move during use. The degree of friction is

however relatively low, so that it does not impede manual or motor-driven rotation of the cam when the position of the squab is being adjusted.

The compressed friction disc (122) provides a thrust that acts axially on the cam (105), urging it towards the squab plate (102). The frusto-conical bearing (119) is offset marginally from its own defined central axis and it therefore provides a biasing force that acts radially on the squab plate (102) (at point "A" in figure 10). This encourages engagement of the pinion and crown teeth (at point "B" in figure 10) and eliminates any tolerance between the cushion plate (101) and the squab plate (102).

As in the first embodiment, the centreline of rotation is offset from the centreline of the cam. The fixed stationary point on the seat is centreline of cam, and the centreline of rotation moves around the centreline of cam in a circular motion the radius of movement being the distance from centreline of cam to centreline of rotation. As the squab is adjusted backwards or forwards the centre of the mechanism rotates, giving a small 'waltzing' movement to the squab.

The third recliner mechanism shown in Figures 11 to 14 is similar in many respects to the second recliner mechanism and the same reference numbers, further incremented by 100 (i.e. starting with 201), have been used for corresponding parts.

The third recliner mechanism comprises a cushion plate (201), a squab plate (202), a cushion clamp plate (203), a squab clamp plate (204), an eccentric cam (205) and four through plate tubular rivets (206).

The cushion plate (201) is a fine blanked component with an outer external toothed ring (207a) and an inner external toothed ring (207b) semi-sheared out of the base material. The outer external toothed ring (207a) is of larger diameter than the inner external toothed ring (207b), which has an inverted tooth form. In the centre of the toothed ring is a hole (208) that provides the first side of a trunnion bearing for the eccentric cam (205). Two holes at the bottom of the plate are for the tubular rivets (206). Both toothed rings (207a, 207b) have 29 equally spaced teeth.

The squab plate (202) is a fine blanked component with an outer internal toothed ring (210a) and an inner internal toothed ring (210b) semi-sheared out of the base material. The outer internal toothed ring (210a) is of larger diameter than the inner internal toothed ring (210b), which has an inverted tooth form. In the centre of the toothed ring is a hole (211) that provides the second side of a trunnion bearing for the eccentric cam (205). The hole (211) has a frusto-conical form with inclined walls, as shown in Fig. 10. Two holes (212) at the top of the plate (202) are for the tubular rivets (206). Both toothed rings (210a, 210b) have 30 teeth equally spaced, with profiles that give touch contact points with the teeth on the cushion plate (201). The outer external and internal toothed rings (207a, 210a) serve as the primary load carrier and the inner external and internal toothed rings (207b, 210b) serve as the secondary load carrier.

As in the first recliner mechanism, the profiles of the internal and external toothed rings (207a,b and 210a,b) are designed so that the teeth of the two pairs of rings make contact with one another around substantially the entire circumference of the rings. Owing to the fact that the external rings have one less tooth than the internal rings, the degree of engagement varies from one tooth to the next, such that the teeth are fully engaged on one side of the mechanism and fully disengaged on the opposite side. This arrangement removes practically all free play (chuck) from the mechanism, within manufacturing tolerances.

The cushion clamp plate (203) is a simple toggled component having two holes (213) at the bottom through which pass the tubular rivets (206) to clamp it onto the cushion plate (201). Through the tubular rivets pass the main fixing bolts (not shown) that attach the mechanism to the cushion frame. The clamp plate (203) includes an offset arcuate flange (214) that overhangs the squab plate (202) to stop the mechanism separating in use, whilst still allowing the squab plate to revolve.

The squab clamp plate/pivot support (204) is also a simple toggled component having two holes (215) through which pass the tubular rivets (206) to clamp it onto the squab plate (202). The clamp plate (204) includes an arcuate flange (216) that

overhangs the cushion plate (201) to stop the mechanism separating in use, whilst still allowing the cushion plate (201) to revolve.

The cam (205) includes an eccentric circular cam profile (218) that is designed to engage the hole (208) in cushion plate (201). A frusto-conical bearing (219) provided on one face of the cam is designed to engage the frusto-conical hole (211) in the squab plate (202). Extending through the cam is a square hole (220). This hole is designed to accept a square shaft on which is mounted either a hand wheel or electric motor with a reduction gearbox (not shown). A circular flange (221) that extends outwards beyond the periphery of the cam profile is provided adjacent the face with the bearing (219). Optionally, an annular friction disc (not shown) may be located on the circular cam profile (218) between one face of the flange (221) and the opposed face of the cushion plate (201).

Various modifications of the mechanism described above are of course possible. For example, the gear-rings and other components of the mechanism may be made using alternative manufacturing methods, such as blanking, broaching, eroding and so on. Various of the components, for example the cam (5), may also have alternative forms or shapes, according to their specific requirements.

FIG 1

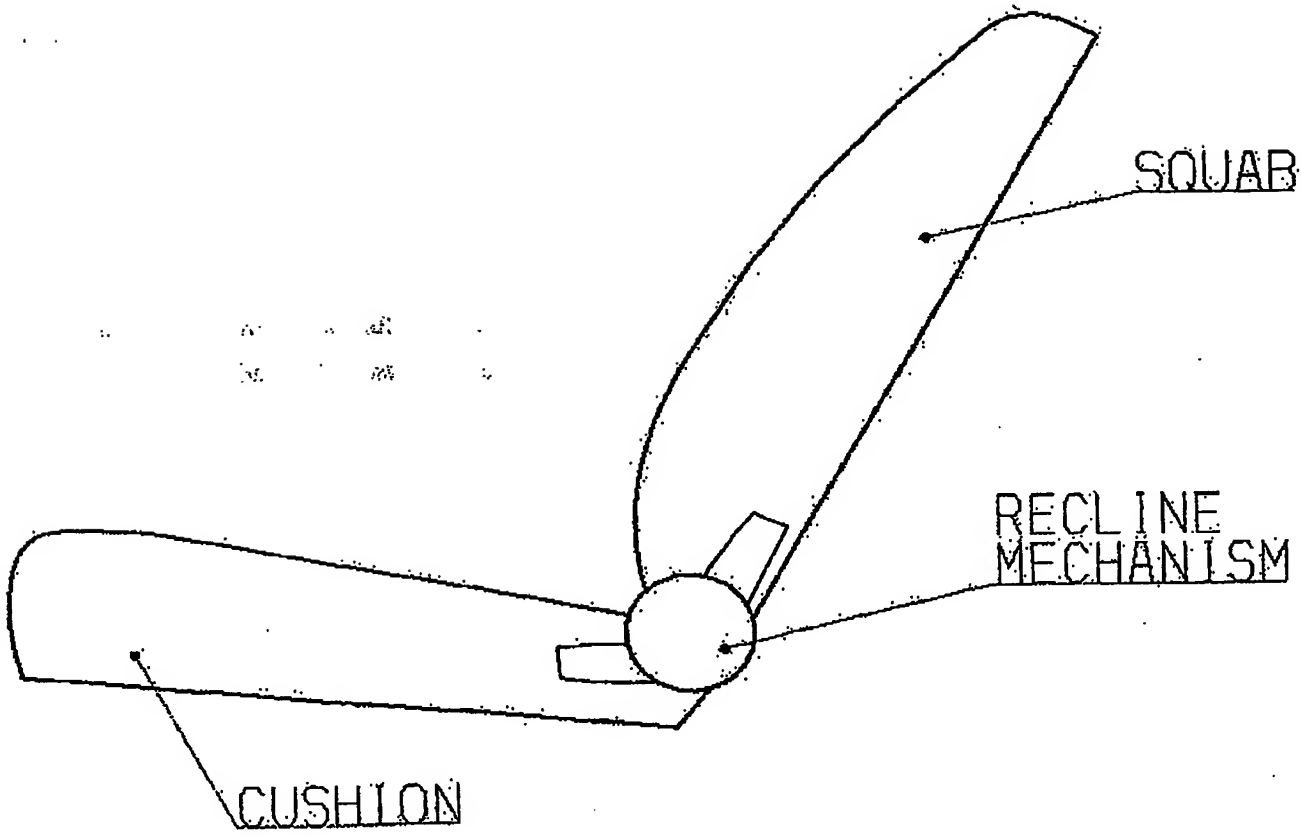


FIG 2

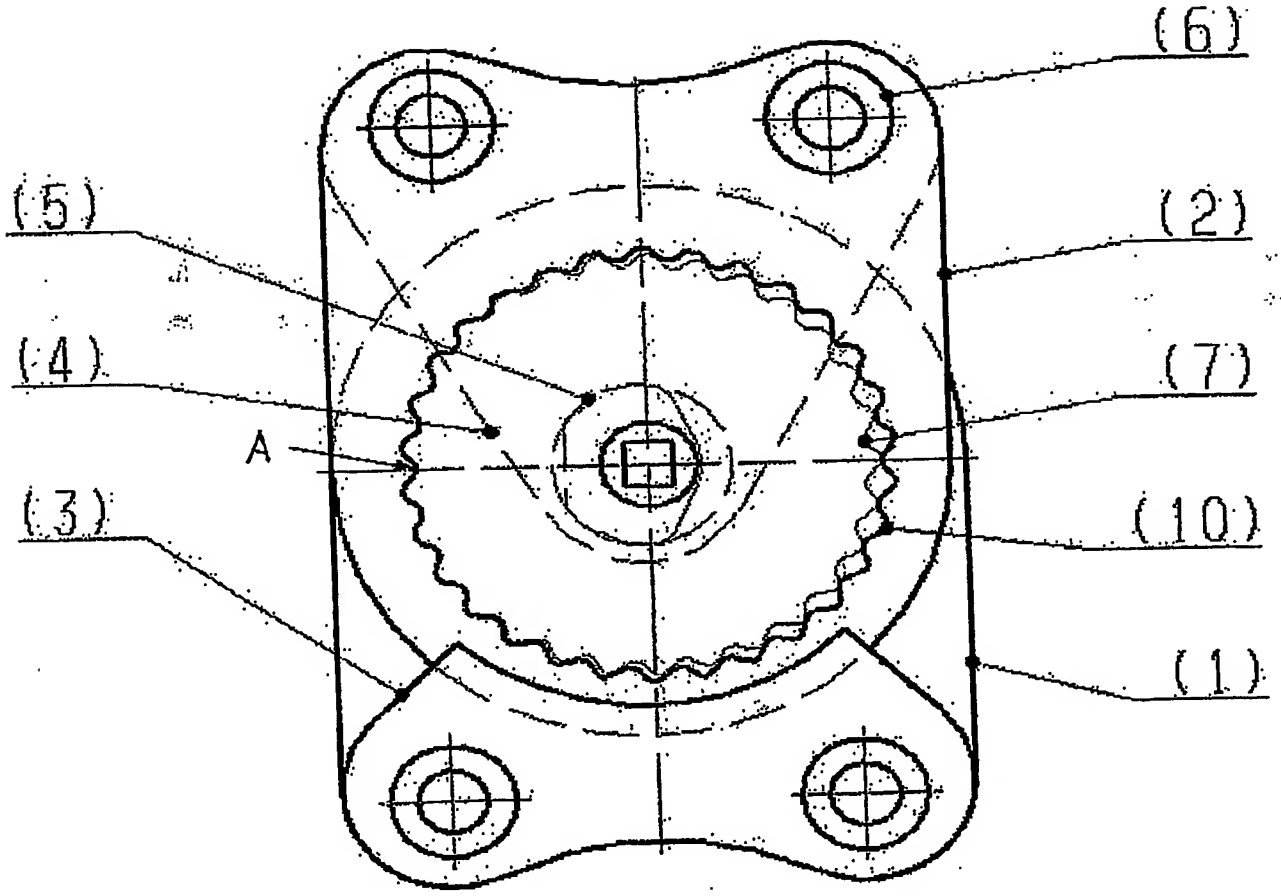


FIG 3

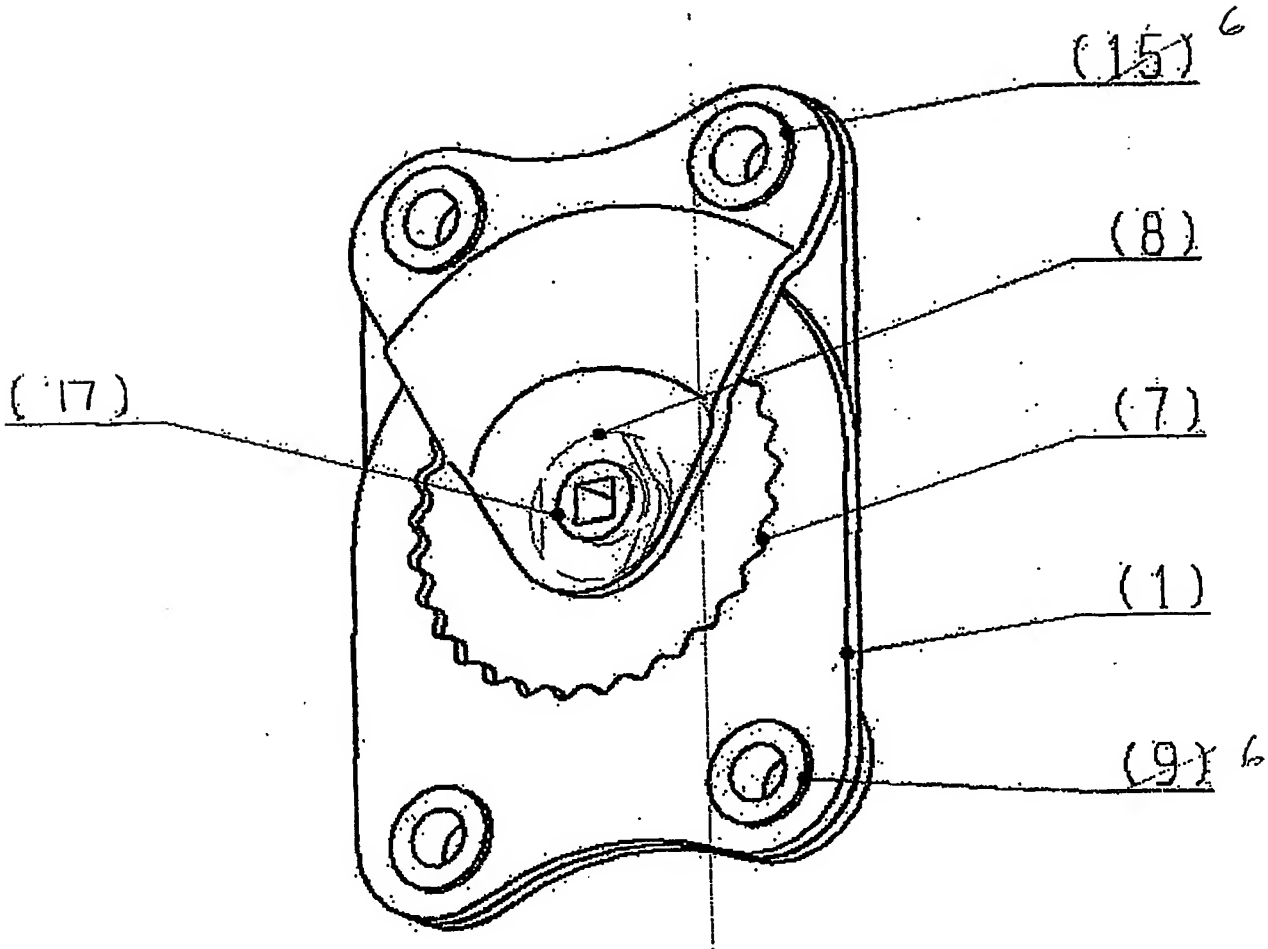
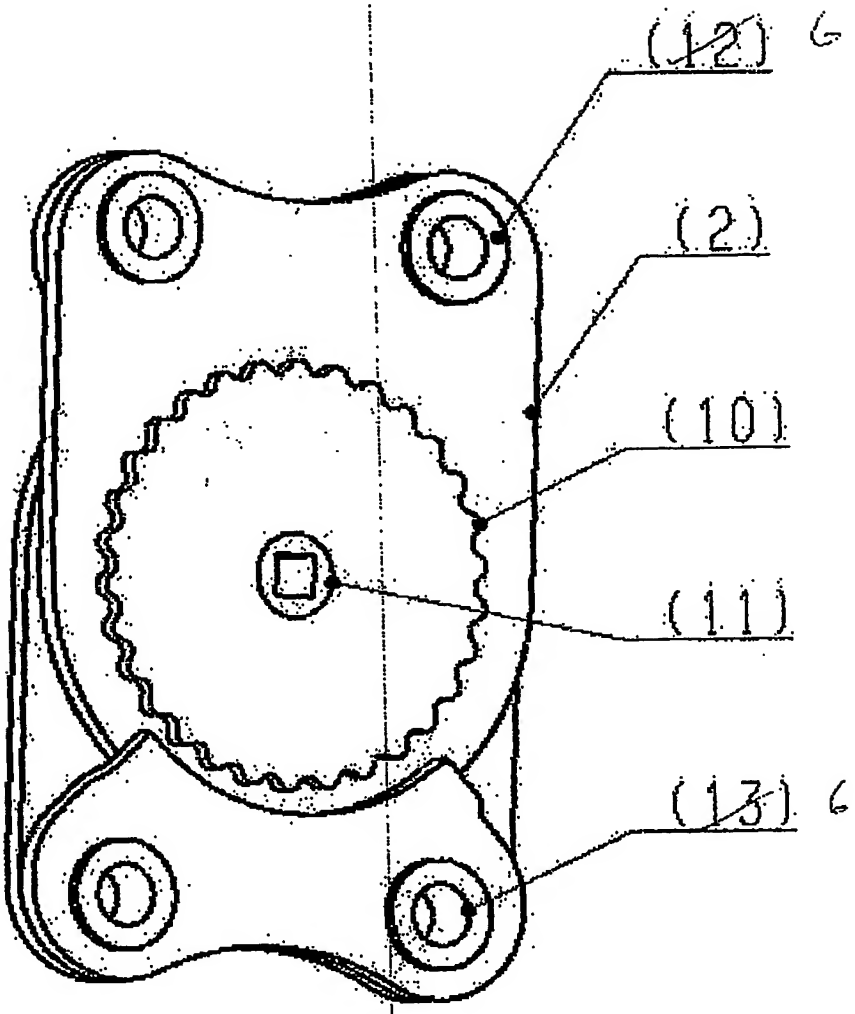


FIG 4



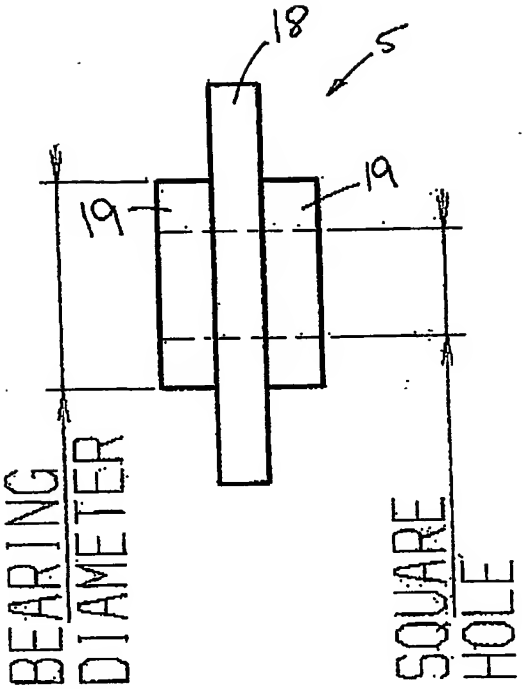


FIG. 5A

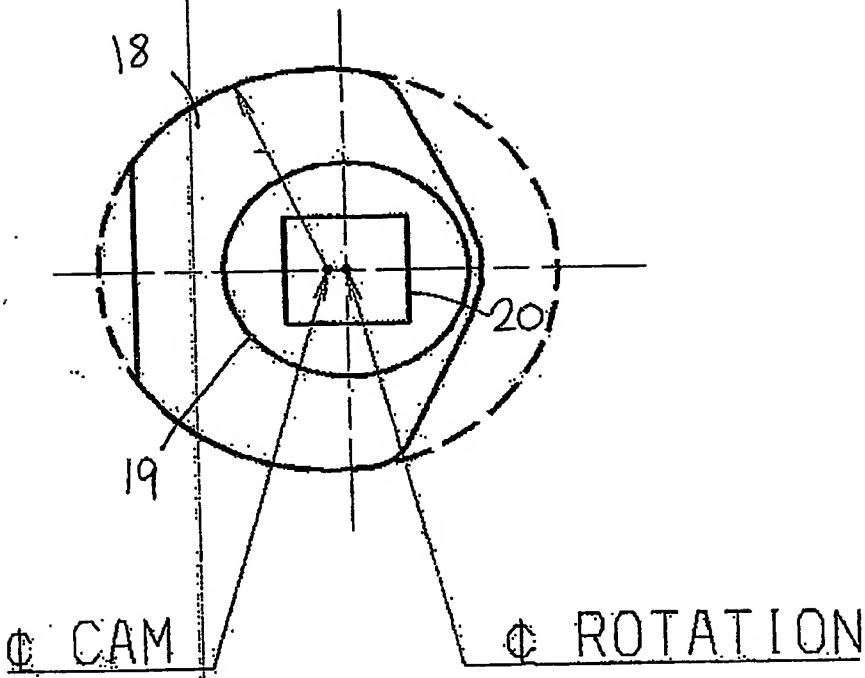


FIG. 5B

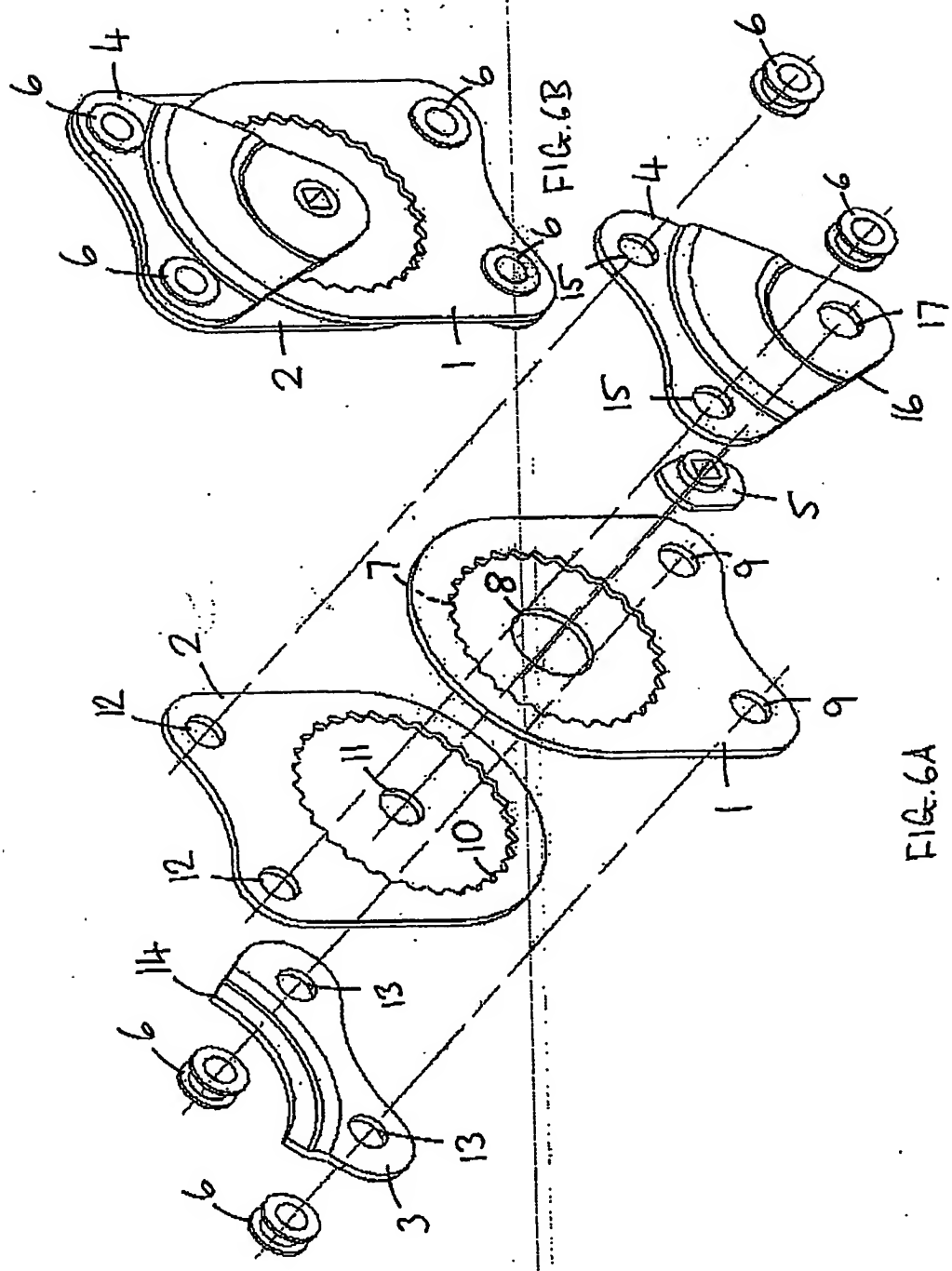


FIG.6B

FIG.6A

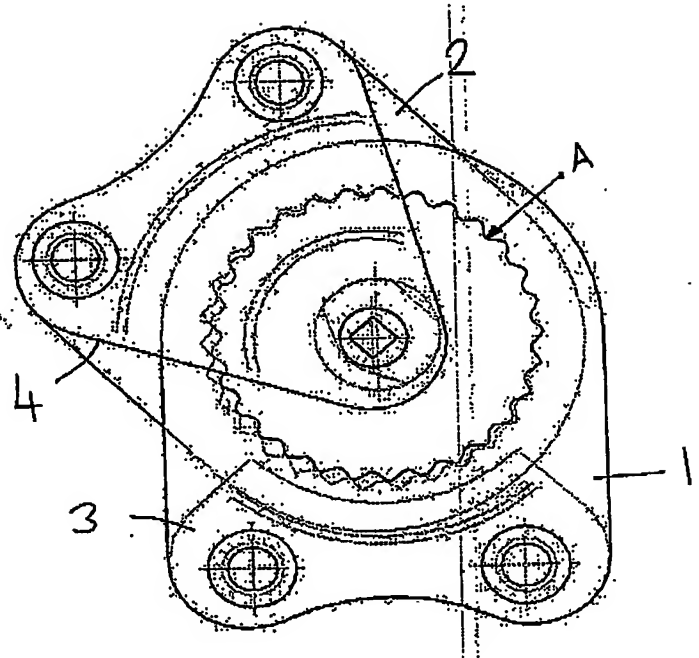


Fig. 7

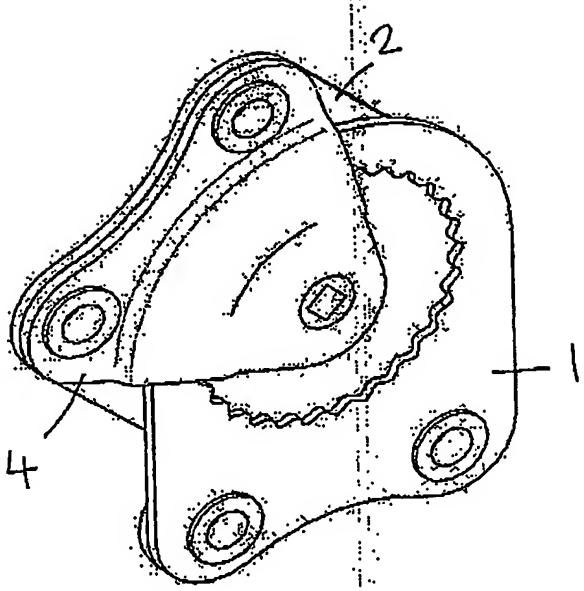


Fig. 8

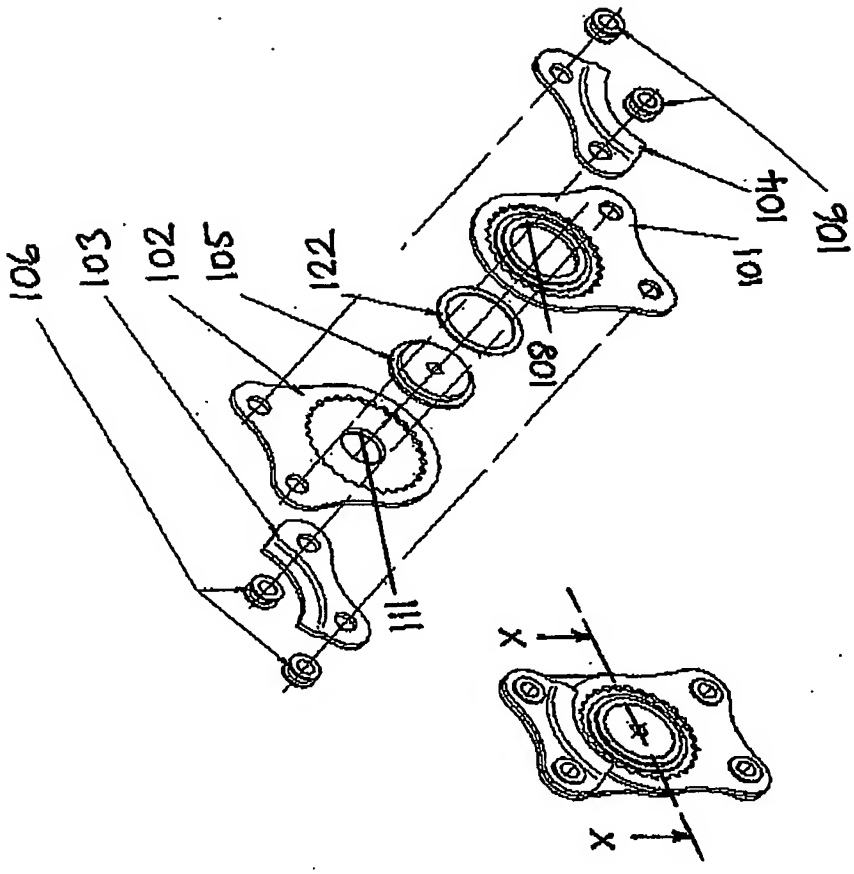


FIG. 9a

FIG. 9b

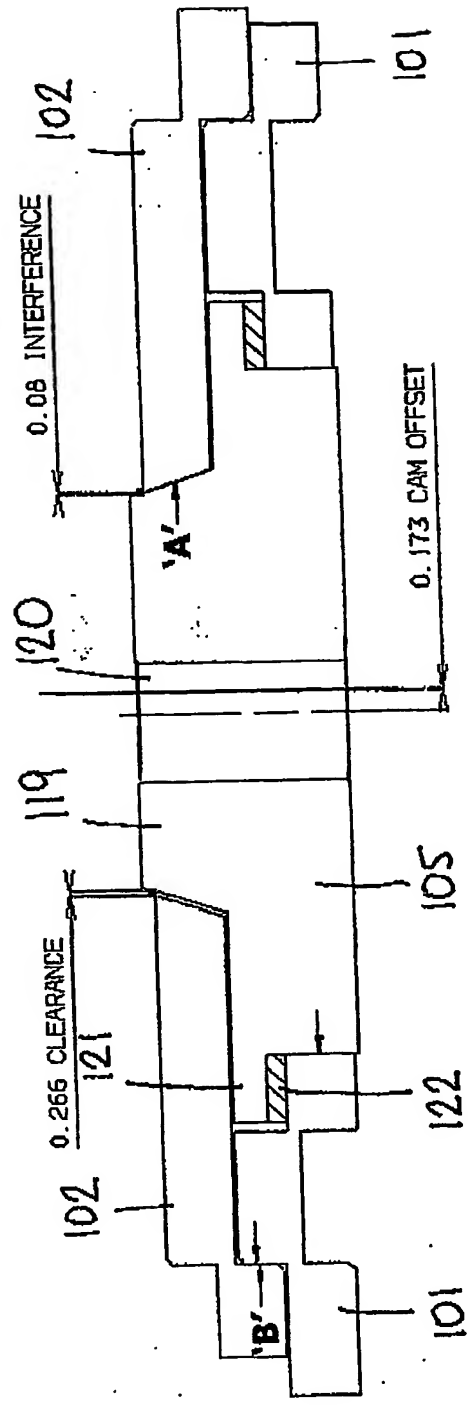

101
102
0.08 INTERFERENCE
'A'
0.173 CAM OFFSET
120
119
105
0.266 CLEARANCE
121
122
102
'B'
101

FIG. 10

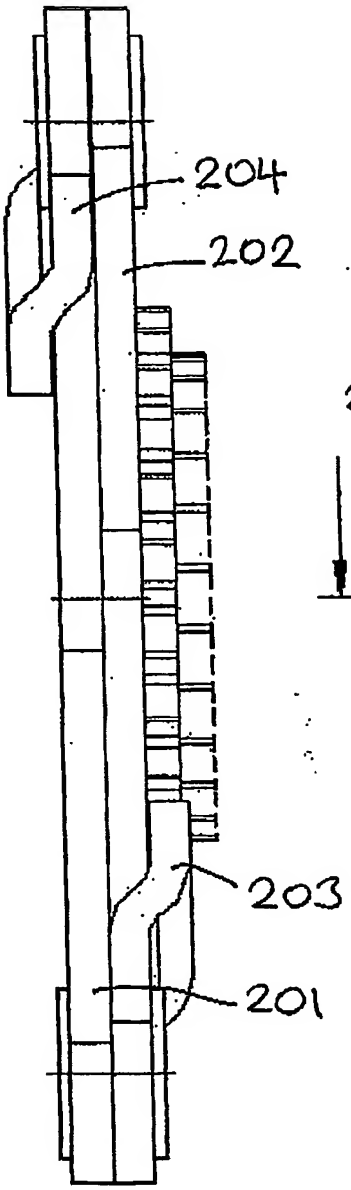

204
202
203
201

FIG.12

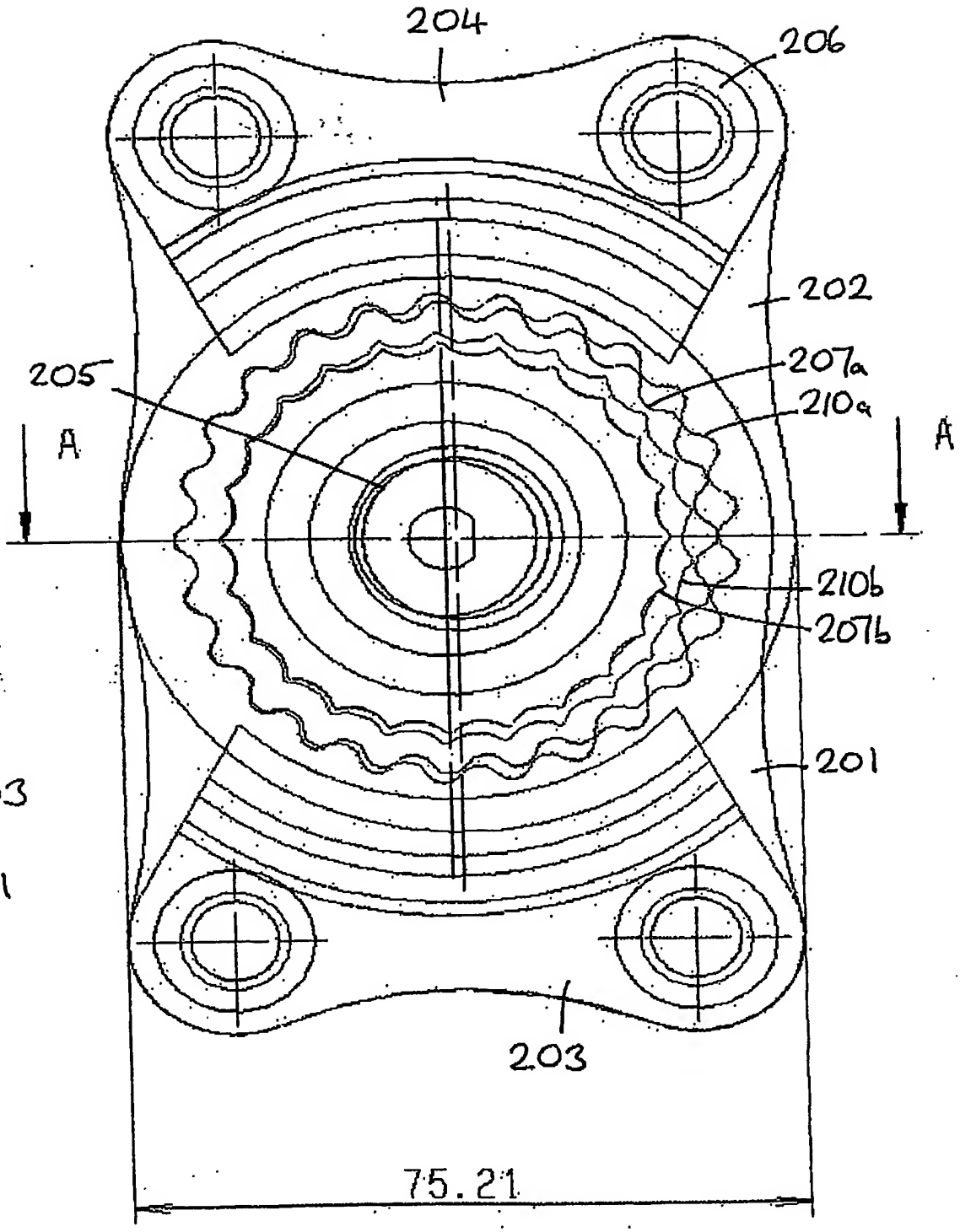

204
206
202
205
207a
210a
A
A
210b
207b
201
203
75.21

FIG.11

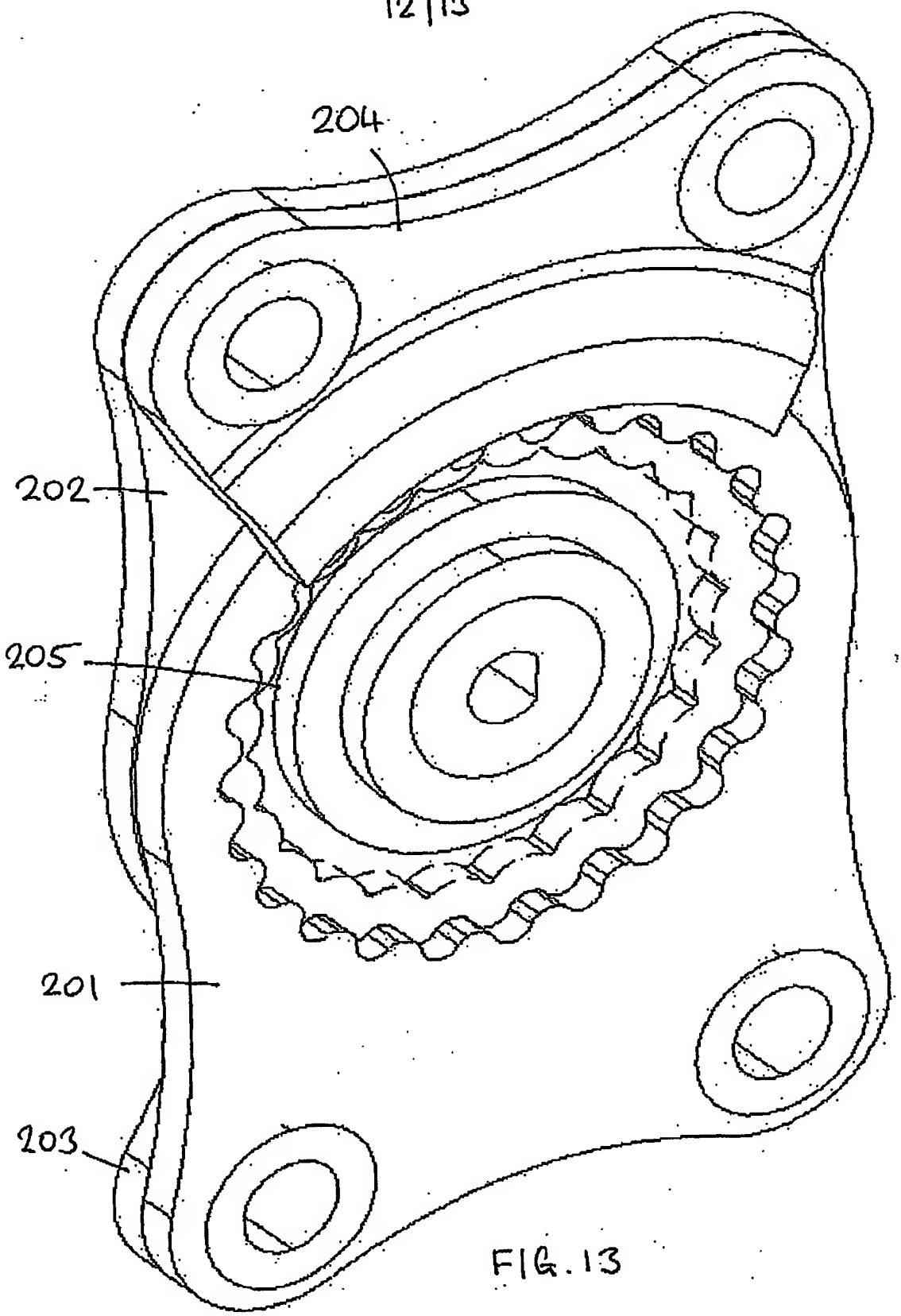


FIG. 13

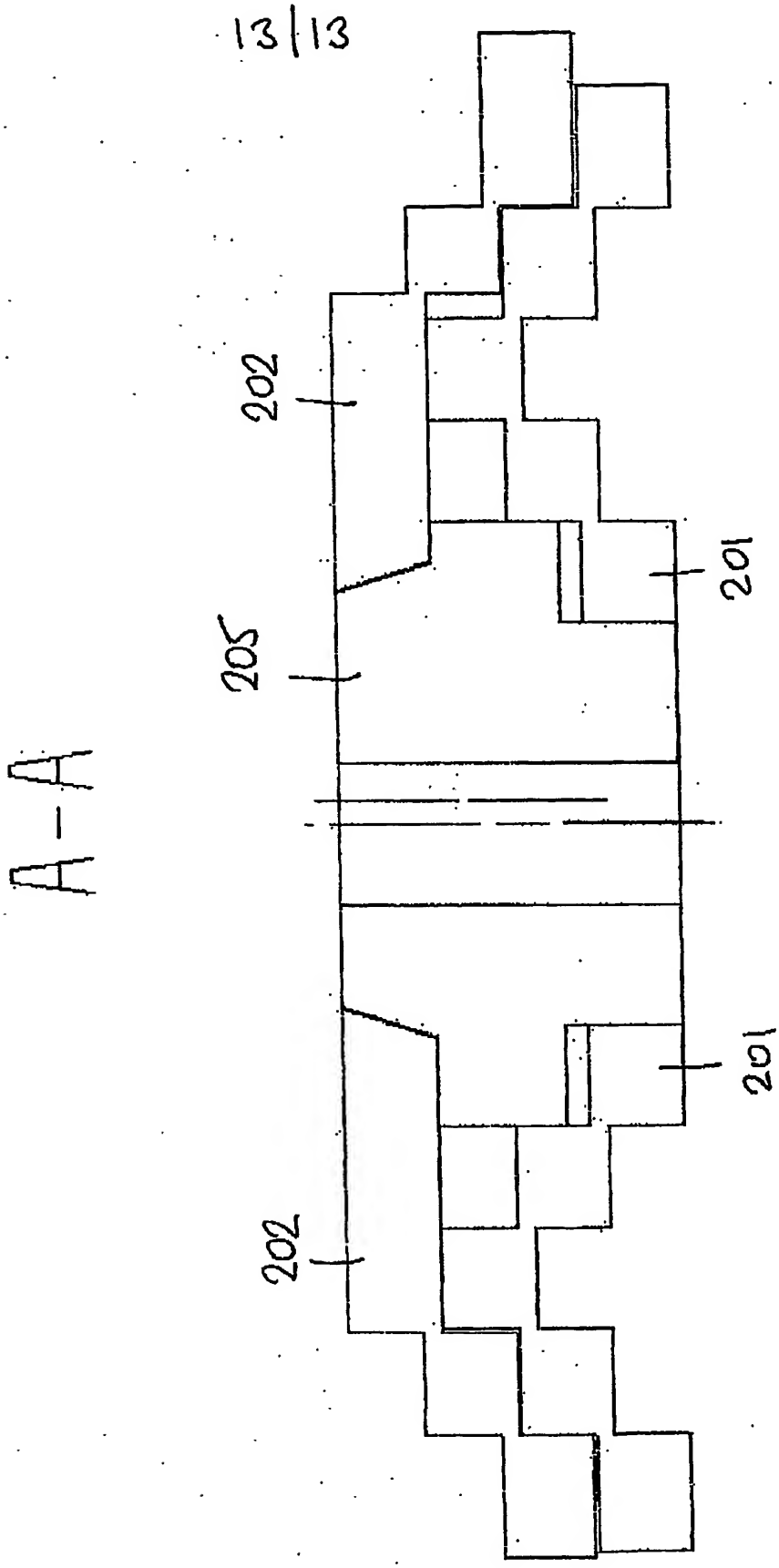


FIG. 14

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